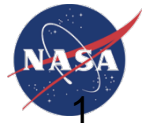
PolInSAR Methods For Ecosystem Science

2011 Carbon Cycle & Ecosystems Joint Meeting



Introduction & Motivation

- **Ecosystem structure scientists (especially on ESWG) exposed frequently to PolInSAR via DESDynI**
- **Considerable uncertainty about efficacy of PolInSAR led to *no ecosystem requirements* on the InSAR segment of previous DESDynI mission**
  - **Lack of US ecosystem community experience with polInSAR**
  - **Lack of peer-reviewed papers**
  - **Lack of access to airborne and field data sets to assess utility**
  - **Great worry over temporal decorrelation**

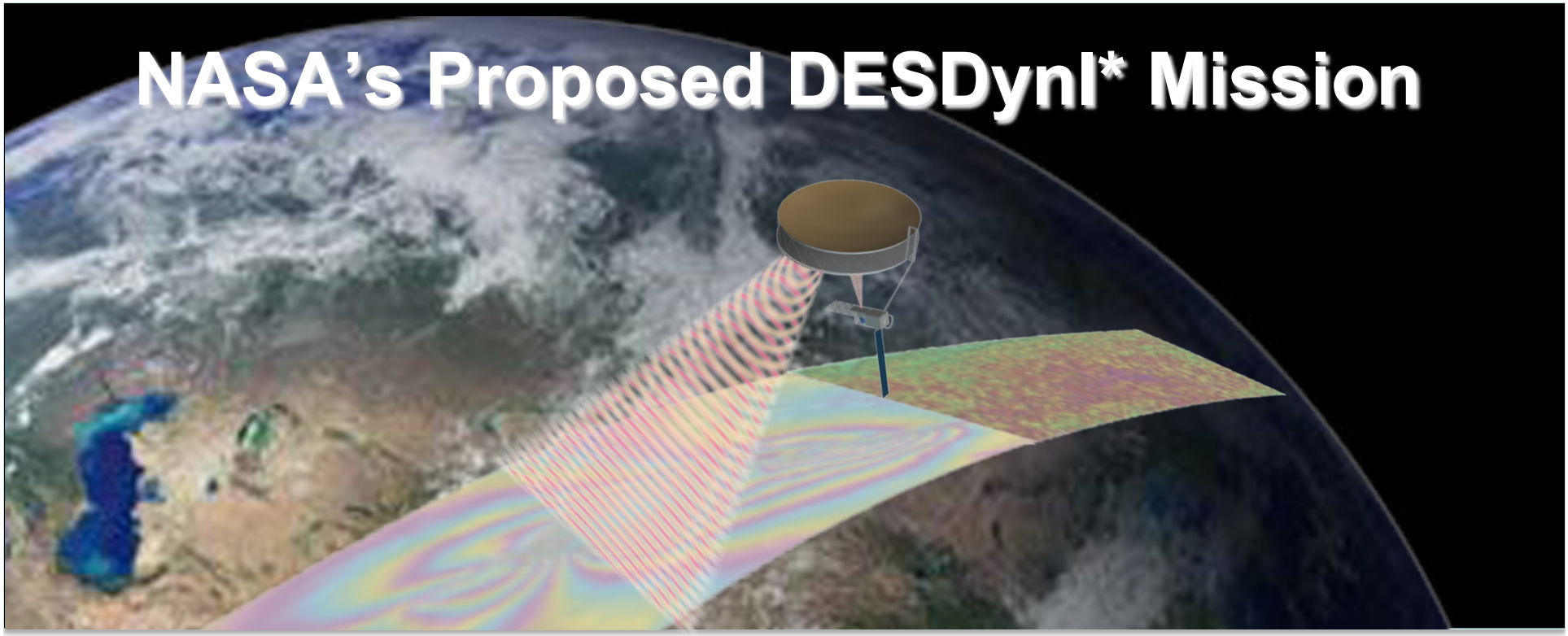
Introduction & Motivation

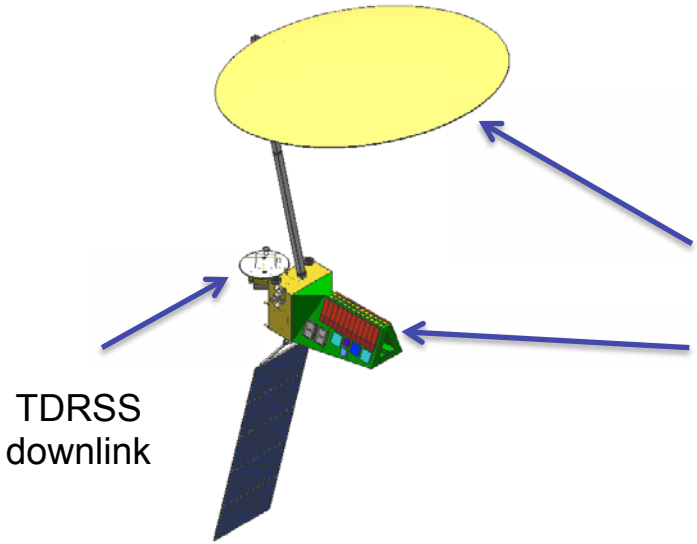
- DESDynI Science Steering Group (DSSG) and broader ESWG recognized the potential of PolInSAR
  - Terrestrial Ecology funded exploration of algorithm development and field experiments (UAVSAR/LVIS joint deployments).
- Discussion about a potential joint PolInSAR mission with DLR (TANDEM-L) with previous DESDynI mission
  - Development of draft science requirements
  - Draft statement from AGU 2010 meeting
    - *"The Ecosystem Structure team strongly supports the pursuit of Tandem-L in the DESDynI Project"*

Introduction & Motivation

- **Cancellation of DESDynI lidar unfortunate and helped motivate the present meeting**
  - ***"Our community's options for structural measurements in the near-term have been much constrained during the past year, and we need to be able to understand and assess our remaining options."***
  - **Community examining potential/efficacy of ICESAT2 for vegetation structure -> great uncertainty**
- **Progress on potential joint missions (e.g. BIOMASS & TANDEM-L) predicated on mutual understanding and comprehension**
- **Joint science meeting is long overdue**
  - **Potential joint experiment would be be exceptionally useful**
- **First step in all these activities is exposure of US ecosystem community to potential of PolInSAR**

NASA's Proposed DESDynI* Mission





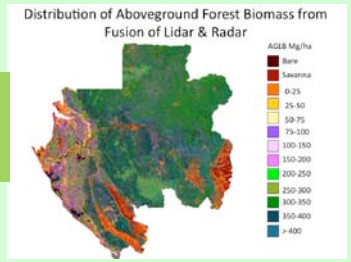
Radar designs for proposed DESDynI mission being studied in pre-Phase A

L-band 5-80 MHz BW Quad-pol Radar
9-15 m mesh reflector
12-24 element transmit and receive array
12-24 dual-pol receive channels
180-360 km swath, full res, full-pol
Better than -25 dB NES0 at 20 MHz BW

***DESDynI - Deformation, Ecosystem Structure, and Dynamics of Ice**

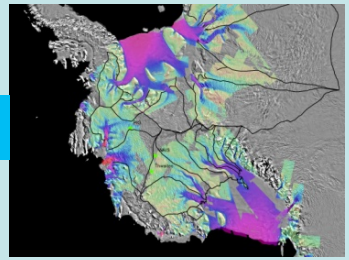
January 2011 MCR DESDynI Concept Must be re-thought Due to Current OMB Direction

Ecosystem Structure



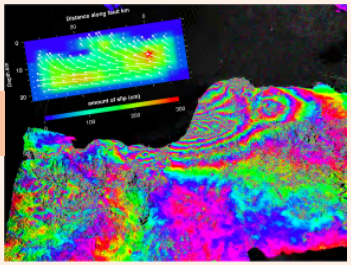
Biomass, Vegetation Structure,
Effects of changing climate on habitats and CO_2, disturbance

Cryosphere



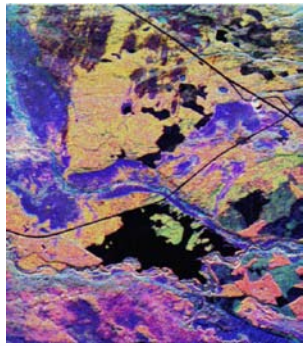
Ice velocity, thickness
Response of ice sheets to climate change & sea level rise

Solid Earth



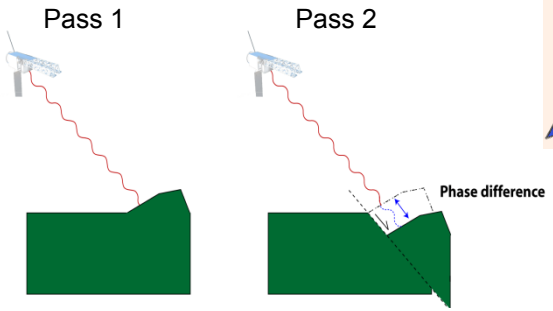
Surface Deformation
Geo-Hazards
Water Resource Management

L-band Polarimetric SAR ?

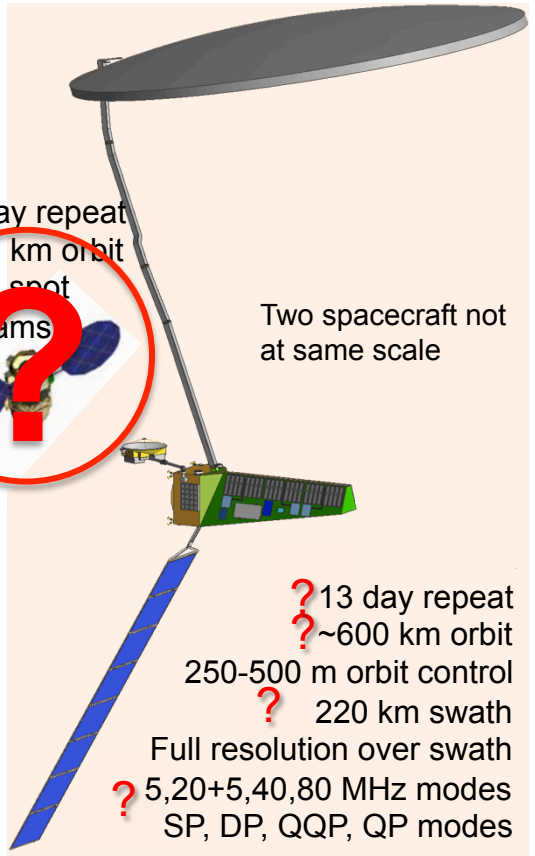


Multibeam Profiling LIDAR

L-band Repeat Pass InSAR



91-day repeat
~370 km orbit
25 m spot
5 beams



Two spacecraft not at same scale

?13 day repeat
?~600 km orbit
250-500 m orbit control
? 220 km swath
Full resolution over swath
?5,20+5,40,80 MHz modes
SP, DP, QQP, QP modes

Outlook for DESDynI

- President's FY12 Budget Proposal (February 2011) reset the go-forward plan for DESDynI
  - Lidar mission to be contributed, not funded by NASA
  - Radar mission to be implemented more affordably
- NASA continues to invest in DESDynI
  - Forming a Science Definition Team
  - Continuing trade studies at JPL
- NASA is currently exploring options for reducing cost
  - Reducing number and scope of science requirements levied on DESDynI
    + DESDynI in combination with other satellites to approach DESDynI requirements
  - Find international partners interested in the science and technology
    + Ongoing Tandem-L studies with DLR
    + Ongoing discussions with several potential partners
  - Find domestic partners that would increase utility of DESDynI data

Possibilities with PolInSAR – an SRTM analogy

- Prior to SRTM, most users were familiar with quality and character of topography derived from optical stereo
- Despite a concerted effort, attempts to produce uniform high-quality global topography were unsuccessful
- SRTM was selected as a practical alternative to previously attempted methods to fill the gap in global topography
  - Sponsors recognized that the data characteristics would be different from optical stereo
- SRTM is now a widely used data sets for science and applications
  - Some of its unique qualities (e.g. “electrical height”) are being exploited for canopy height and biomass studies
- Similarly, PolInSAR may be able to fill a gap in global estimates of above-ground biomass and forest structure
- PolInSAR is an extension of SRTM techniques, estimating a number of heights in the canopy to infer structure.